इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 4545-7 (1983): Methods of measurement on receivers for television broadcast transmissions, Part 7: Fidelity [LITD 7: Audio, Video and Multimedia Systems and Equipment]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN
IGNORANTIA JURIS NON EXCUSAT
PROTECTED BY COPYRIGHT

IS : 4545 (Part 7) - 1983

(Reaffirmed 2003)

Indian Standard

METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS

PART 7 FIDELITY

(First Revision)

UDC 621·397·62 : 621·391·83

© *Copyright* 1986

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 10

July 1986

Indian Standard

METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS

PART 7 FIDELITY

(First Revision)

Radio Communications Sectional Committee, LTDC 20

Chairman	*Representing*
Shri H. S. Jolly	All India Radio, New Delhi
Members	
Shri O. P. Khushu (*Alternate* to Shri H. S. Jolly)	
Additional Director Standards (S & T)	Ministry of Railways (RDSO)
Joint Director Standards (S & T) - IV (*Alternate*)	
Cdr S. S. Baidwan	Ministry of Defence (DPI) (N), New Delhi
Lt-Cdr A. Bhomick (*Alternate*)	
Shri A. K. Basak	Development Commissioner, Small Scale Industry, New Delhi
Shri V. V. R. Prabhu (*Alternate*)	
Shri H. M. Bhatnagar	Indian TV Manufacturers Association, New Delhi
Shri V. K. Sethi (*Alternate*)	
Shri H. S. Chandramouli	Bharat Electronics Ltd, Bangalore
Shri K. Ramaseshu (*Alternate*)	
Shri R. G. Deodhar	Wireless Planning and Co-ordination Wing (Ministry of Communications), New Delhi
Shri M. L. Dhar	Directorate General of Civil Aviation, New Delhi
Shri P. K. Dhingra (*Alternate*)	
Shri A. K. Ghose	Indian Telephone Industries Ltd, Bangalore
Shri N. Krishnan Kutty (*Alternate*)	
Shri B.P. Ghose	National Test House, Calcutta
Shri B. C. Mukherjee (*Alternate*)	
Shri J. Gupta	The Radio Electronic & Television Manufacturers Association (RETMA), Bombay
Shri T. S. Buxi (*Alternate*)	
Shri J. Gupta	Peico Electronics & Electricals Ltd, Bombay
Shri P. S. Sachdev (*Alternate*)	
Shri B. S. Gupta	Federation of Associations of Small Industries of India, New Delhi
Dr S. K. Hajela	Institution of Electronics and Telecommunication Engineers, New Delhi
Shri S. Janakiraman	Directorate of Coordination (Police Wireless), Ministry of Home Affairs, New Delhi
Shri R. P. Mathur (*Alternate*)	
Lt-Col Krishan Lal	Ministry of Defence (DGI), New Delhi
Lt-Col B. S. Natrajan (*Alternate*)	

(*Continued on page* 2)

© *Copyright* 1986
INDIAN STANDARDS INSTITUTION
This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(Continued from page 1)

Members	*Representing*
Shri R. Lalwani	Posts & Telegraphs Board, New Delhi
Shri V. V. Chaudhary (*Alternate*)	
Shri R. C. Pandey	Ministry of Defence (DTD & P) (AIR), Bangalore
Shri C. M. Krishna Murthy (*Alternate*)	
Shri A. K. N. Prasad	Hindustan Aeronautics Ltd, Bangalore
Shri M. G. Sridharan (*Alternate*)	
Shri W. V. Ramana	Electronics Corporation of India Ltd, Hyderabad
Shri K. P. Ramaswamy	Directorate General of Doordarshan, New Delhi
Shri K. B. Borker (*Alternate*)	
Shri P. K. Rangole	Central Electronics Engineering Research Institute, Pilani
Shri H. K. Jain (*Alternate*)	
Shri M. Sankaralingam	Directorate General of Supplies and Disposals, New Delhi
Shri R. S. Arora (*Alternate*)	
Shri S. Sharma	Department of Electronics, New Delhi
Dr K. S. K. Sai (*Alternate*)	
Shri C. G. Subramanyan	Electronics Trade and Technology Development Corporation Ltd, New Delhi
Shri Ishwar Dutt (*Alternate*)	
Shri Suresh Chandra	National Physical Laboratory, New Delhi
Shri K. K. Taneja	Directorate General of Technical Development, New Delhi
Shri H. S. Dubey (*Alternate*)	
Shri C. M. Thirumurthy	Gujarat Communications and Electronics Ltd, Vadodara
Shri N. Srinivasan, Director (Electronics)	Director General, ISI (*Ex-officio Member*)

Secretary

Shri D. K. Nayyar
Assistant Director (Electronics), ISI

Panel for TV Receivers, LTDC 20/P3

Convener	
Shri N. N. Mohanty	All India Radio, New Delhi
Members	
Shri A. S. Guin (*Alternate* to Shri N. N. Mohanty)	
Shri M. L. Arora	M/s Chawla & Company, New Delhi
Assistant Wireless Adviser (Planning-I)	Wireless Planning and Coordination Wing (Ministry of Communication), New Delhi
Shri H. M. Bhatnagar	Indian TV Manufacturers Association, New Delhi
Shri R. B. Lal (*Alternate*)	
Shri R. S. Bhatnagar	Federation of Associations of Small Industries of India Ltd, New Delhi
Shri K. B. Borker	Directorate General of Doordarshan, New Delhi
Shri M. Butchi Raju	Electronics Corporation of India Ltd, Hyderabad
Shri P. Janardhan (*Alternate*)	
Shri R. K. Chakravarti	Department of Electronics, New Delhi
Shri A. Ghaffar	U.P. Electronics Corporation Ltd, Lucknow
Shri S. Janakiram	Information & Public Relations Department, Government of Andhra Pradesh, Hyderabad
Shri K. L. Kandoi	The Radio Electronic and Television Manufacturers Association, Bombay
Shri S. Mitra	Electronic Regional Test Laboratory (North), New Delhi
Shri Inderjeet Banaudha (*Alternate* I)	
Shri C. L. Kaul (*Alternate* II)	
Shri A. Razzaque	Central Electronics Engineering Research Institute, Pilani
Representative	Tamil Nadu Local Administration Radio and Television Manufacturers Organization, Madras
Shri P. K. Sandell	Electronics Trade and Technology Development Corporation Ltd, New Delhi
Shri C. G. Subramanyan (*Alternate* I)	
Shri C. S. Arora (*Alternate* II)	
Shri V. V. R. Sastry	Bharat Electronics Ltd, Bangalore
Shri V. K. Sekhri	Electronic Components Industries Association, New Delhi
Shri Suresh Chandra	National Physical Laboratory, New Delhi
Shri Inderjeet Banaudha (*Alternate*)	

Indian Standard

METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS

PART 7 FIDELITY

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 7) (First Revision) was adopted by the Indian Standards Institution on 6 December 1983, after the draft finalized by the Radio Communications Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The first version of IS : 4545 covered the methods of measurement for television broadcast receivers having monochrome vision reception. With the introduction of colour television receivers, this standard is now being revised to make it applicable to receivers designed for both monochrome and colour vision reception and published in a number of parts to deal with different aspects of characteristics of television receivers.

0.3 This standard (Part 7) covers methods of measurement for fidelity of television receivers. Other parts in this series are :

Part 1 General considerations
Part 2 Tuning properties and general measurements
Part 3 Geometrical properties of the picture
Part 4 Synchronizing quality
Part 5 Sensitivity
Part 6 Selectivity and response to undesired signals
Part 8 Compatibility with audio visual recording equipment
Part 9 Electrical and acoustic measurements at audio frequency

0.4 This standard (Part 7) is largely based on IEC Publication 107-1 (1977) 'Recommended methods of measurement on receivers for television broadcast transmission : Part 1 General considerations and electrical measurements other than those at audio-frequencies', issued by the International Electrotechnical Commission.

0.5 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

---

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 7) covers methods of measurement for parameters relating to fidelity of television receivers, namely:

a) Modulation frequency/response characteristic, luminance and chrominance channel;
b) Linear waveform response luminance and chrominance channel;
c) Black level and its stability;
d) dc component distortion luminance channel;
e) dc component distortion, colour difference signal;
f) dc component distortion, primary colour signal;
g) Errors of chrominance signal demodulation angle;
h) Effects of phase distortion on incoming signal for small picture areas;
j) Luminance/chrominance delay inequality;
k) G-4 signal matrixing error;
m) Primary colour signal matrixing error;
n) Spurious line sequential effects; and
p) Line time non-linearity.

1.2 This standard (Part 7) shall be read in conjunction with IS : 4545 (Part 1) - 1983*.

---

*Methods of measurement on receivers for television broadcast transmissions: Part 1 General considerations (*first revision*).

2. GENERAL

2.1 The overall electrical fidelity is the response at the picture tube electrodes to all modulation frequencies from zero up to the limit of the system for which the receiver is intended, the modulated radio-frequency signal being applied to the receiver input terminals through a suitable matching network.

NOTE — Where electrodes of the picture tube other than those used for measurement are not adequately decoupled, care shall be taken in interpreting the results of the measurements.

Three types of measurement are described:

a) The modulation-frequency response from 100 kHz upwards,

b) Response to limited spectrum pulse and bar signals, and

c) The low-frequency response.

2.2 Influence of Vestigial Side-band Filter — A vestigial side-band filter need not be used with the radio-frequency signal source if the combined radio-frequency/intermediate frequency circuits of the receiver sufficiently limit the radio-frequency spectrum. When it is desired to know if the spectrum is so limited, the radio-frequency/intermediate frequency response of the receiver shall be measured as described in **2.2** and **3.2** of IS : 4545 (Part 6) - 1983*.

The vestigial side-band filter mentioned in the following clauses shall be introduced if the area *B* of the portion of the radio-frequency/intermediate frequency response curve indicated in Fig. 1 is greater than 2 percent of the area *A* within the passband.

---

*Methods of measurement on receivers for television broadcast transmissions: Part 6 Selectivity and response to undersired signals (*first revision*).

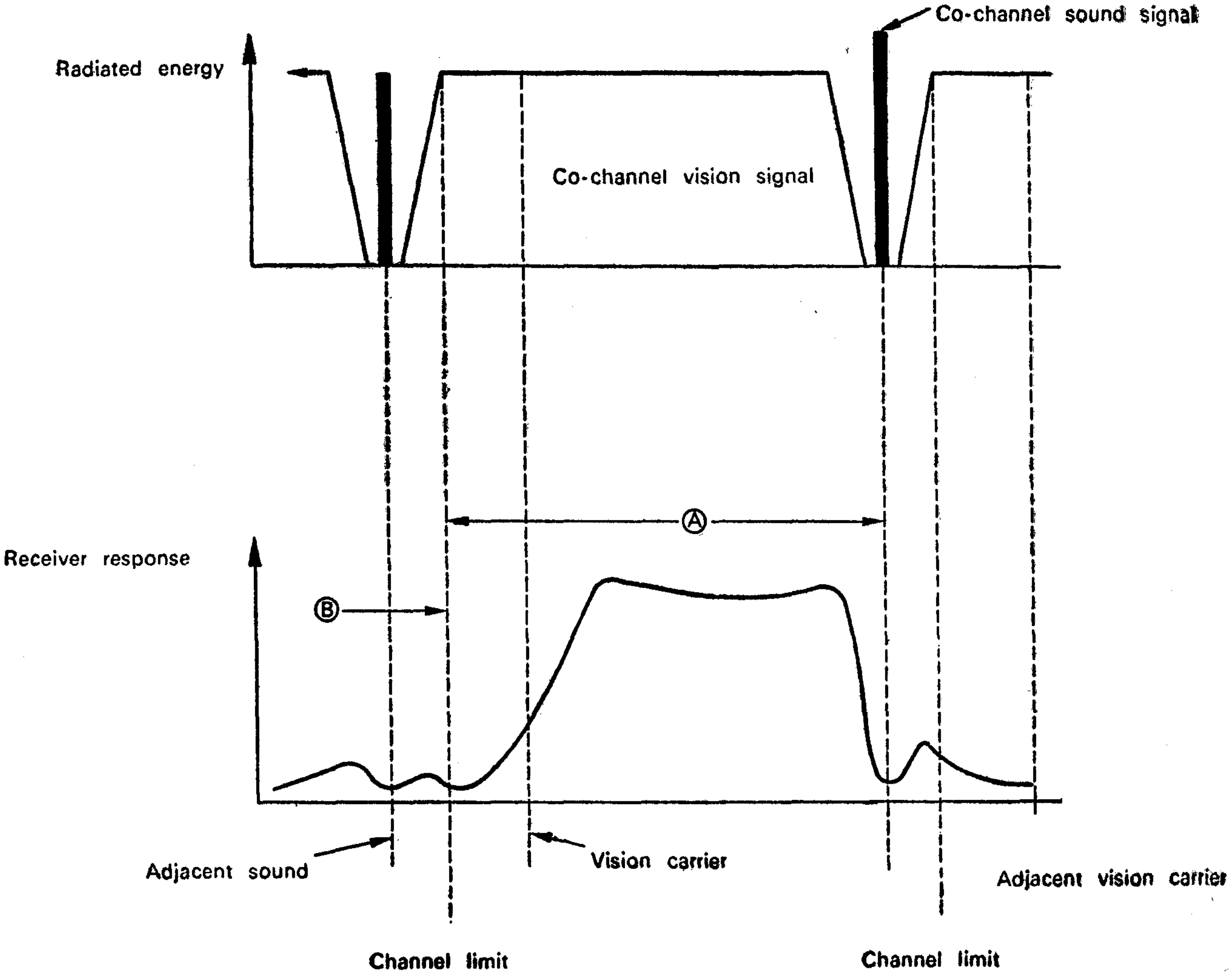


FIG. 1 EXAMPLE OF ANALYSIS OF RECEIVER SELECTIVITY FOR APPLICATION OF VESTIGIAL SIDE-BAND FILTER

Where a vestigial side-band filter is used, care shall be taken that the resultant signal is free from group delay errors, and that any pre-correction of the group delay characteristic required by the system standard in use is fulfilled.

3. MODULATION-FREQUENCY/RESPONSE CHARACTERISTIC, LUMINANCE CHANNEL

3.1 Definition — The luminance channel modulation-frequencies/response characteristic represents the amplitude of the luminance signal picture modulation at the picture tube electrodes as a function of the modulation frequency.

3.2 Method of Measurement — The modulation-frequency/response characteristic in the range from approximately 100 kHz upwards is measured on a representative range of channels in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983* and the method used stated in the results.

The radio-frequency carrier is modulated with a video signal having sinewave picture modulation, adjustable to swing over the following ranges:

a) Black level to white level,

b) 25 to 75 percent picture modulation, and

c) 40 to 60 percent picture modulation.

The radio-frequency signal is applied to the input terminals of the receiver through a vestigial side-band filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983† so that noise effects do not influence measurement.

The receiver is adjusted to provide standard video output voltage.

On at least one channel, the measurement shall also be carried out with maximum and minimum input signal levels as defined in **5** and **15** of IS : 4545 (Part 5) - 1983†.

When a luminance channel response control is provided, measurements shall be carried out in each position where it is switchable and over a range of positions where it is continuously adjustable. When automatic control is provided modifying the response when a colour signal is received, measurements shall be carried with and without the chrominance signal reference burst or chrominance carrier signal included.

When a vision interference limiter control is provided, it shall be set to give the least effect on the picture.

An oscilloscope is connected in place of the picture tube in such a manner that the frequency response of the video circuits is unchanged and the electrodes continue to have suitably applied potentials. In a colour receiver each electrode driven by the luminance signal, either directly or as a component of a primary colour signal is to be measured.

The level of the picture modulation is kept constant, the frequency being varied between approximately 100 kHz and the sound/vision carrier-frequency difference. The peak-to-peak amplitude of the picture modulation either side of mid-grey level displayed on the oscilloscope is plotted as a function of the modulation frequency.

The measurements are carried out for the three levels of picture modulation defined above.

Measurement may be carried out by means of a video sweep generator instead of the sinewave signal generator, the result being displayed on a suitable indicator.

3.3 Graphic Representation — The amplitude of the picture modulation of the waveform displayed on the oscilloscope is plotted as a function of the modulation frequency. When a swept signal is used, the result may be recorded.

The frequency scale on the abscissa and the amplitude scale on the ordinate may be either linear or logarithmic (*see* Fig. 2).

4. LINEAR WAVEFORM RESPONSE, LUMINANCE CHANNEL

4.1 Definition — The linear waveform response, luminance, is the waveshape measured at the picture tube electrode or electrodes when applying the stated limited spectrum test signals to the input terminals of the receiver. The results are expressed as a percentage of the difference between black level and maximum white level. A rating factor K may also be used in some cases; this allows for the differing subjective effects of the various distortions.

Alternatively, the results may be presented by photographic records of the various waveforms.

Four types of response measurement are described indicating the frequency and group delay response throughout the video frequency range:

a) Line rate bar response,

b) Pulse response,

c) Pulse-to-bar ratio, and

d) Field frequency square wave response.

---

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

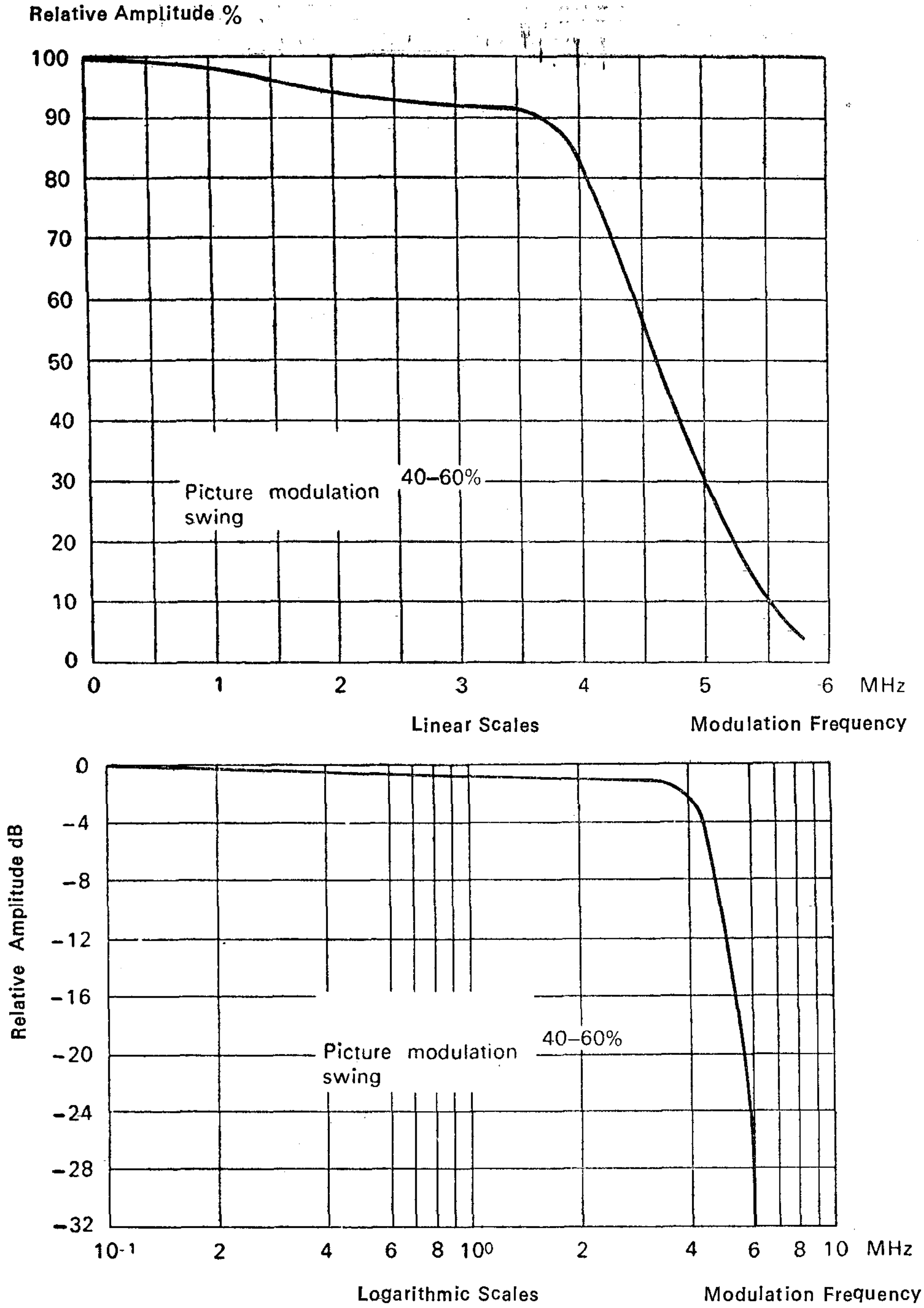


FIG. 2 EXAMPLES OF MODULATION FREQUENCY/RECEIVER RESPONSE CHARACTERISTICS

4.2 Method of Measurement — The response *a*, *b*, *c* and *d* to the appropriate signal are measured on a representative range of the channels in which the receiver is designed to operate. The receiver must be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983*.

The radio-frequency signal is modulated with a video signal corresponding to a 2 T pulse and bar, a field-rate square wave and a composite 2 T_c pulse and bar.

$$T = \frac{1}{2f_c}$$

where

f_c is the nominal upper video frequency limit of the system.

$$T_c = \frac{1}{2f_{cc}}$$

where

f_{cc} is the difference between f_c or the upper limit of the chrominance signal passband, whichever is the lower value, and the chrominance sub-carrier frequency.

---

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

Suitable networks for band-limiting the spectrum of pulse and bar signals are shown in Fig. 3.

The waveforms of the test signals are shown in Fig. 4.

The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted to be between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983* and such that noise effects do not influence measurement.

Where the system in use requires that the signal be pre-corrected for receiver group delay characteristic. This pre-correction must be included in the test signal generator.

The receiver is adjusted to provide standard video output voltage.

On at least one channel the measurements shall be carried out with maximum and minimum input signal levels as defined in **5** and **15** of IS : 4545 (Part 5) - 1983*.

When a luminance channel response control is provided, measurements shall be carried out in each position where it is switchable and over a range of positions where it is continuously adjustable. When automatic control is provided modifying the response when a colour signal is received, measurements shall be carried with and without the chrominance signal reference burst or chrominance sub-carrier signal included.

When a vision interference limiter control is provided it shall be set to give least effect upon the picture.

An oscilloscope is connected in place of the picture tube in such a manner that the frequency response is unchanged and the electrodes continue to have suitably applied potentials. In a colour receiver, each electrode driven by the luminance signal, either directly or as a component of a primary colour signal, shall be measured.

4.3 2 *T* Bar Response — The oscilloscope is adjusted as shown in Fig. 5 so that the half-amplitude points of the bar transitions coincide with points m_1 and m_2. Points A and B respectively at black level and the mid-point of the bar are then set at unit-amplitude. The maximum departure b of the bar from unit-amplitude between points extending to 0·01 H from the half-amplitude points of each transition is measured and expressed as a percentage of the difference between black level and white level. The result may be expressed in terms of the rating factor K using the expression given below.

K rating of 2 T bar response expressed as a function of b:

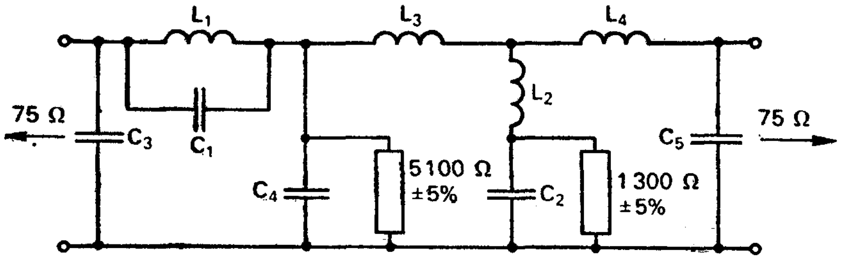
$$K = | b - 100 |$$

4.4 2 *T* Pulse Response — The oscilloscope is adjusted as shown in Fig. 6 such that the sweep velocity corresponds with the time scale indicated, the black level of the response coincides with the horizontal axis and the peak of the response falls on the unit-amplitude line and the half-amplitude points of the response are symmetrically disposed about the vertical axis.

The amplitude of the signal is measured at the indicated points on the horizontal axis and expressed as percentage b of the peak response. The difference in time a between the half-ampli-

---

*Methods of measurement on receivers for television broadcast transmissions : Part 5 Sensitivity (*first revision*).



$L_1 = T(9{,}478) \pm 1\%$
$L_2 = T(1{,}851)^*$
$L_3 = T(18{,}546) \pm 1\%$
$L_4 = T(18{,}207) \pm 1\%$

$C_1 = T(475{,}25) \pm 2\%$
$C_2 = T(13006) \pm 0{,}5\%$
$C_3 = T(4554{,}5) \pm 2\%$
$C_4 = T(3399{,}3) \pm 0{,}5\%$
$C_5 = T(998{,}8) \pm 2\%$

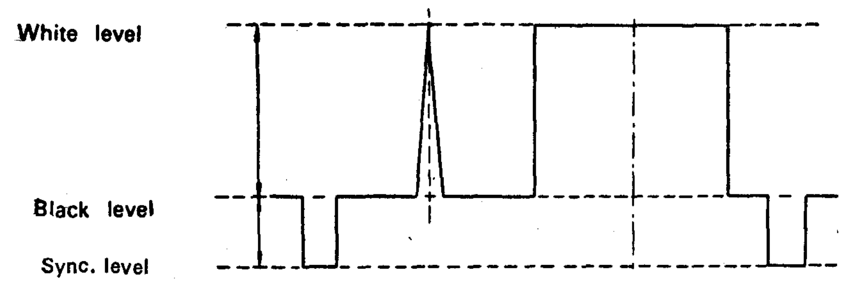
Inductances to have $Q \geqslant 100$

*Adjusted for minimum response at $f = \frac{1{\cdot}025\,9}{T}$

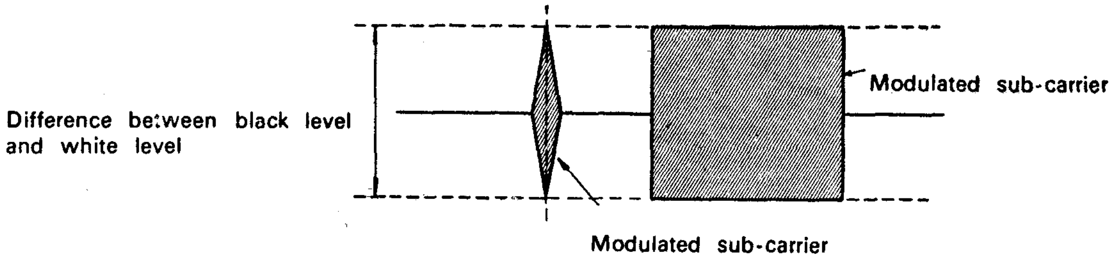
Exciting Pulse $\leqslant \frac{T}{5}$

Induction values are in microhenrys
Capacitance in picofarads
Frequency in Megahertz
Time in microseconds

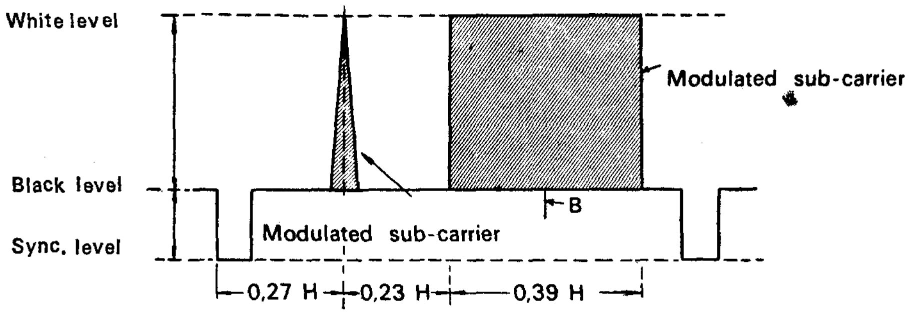
FIG. 3 SUITABLE NETWORKS FOR BAND-LIMITING PULSE AND BAR SIGNALS



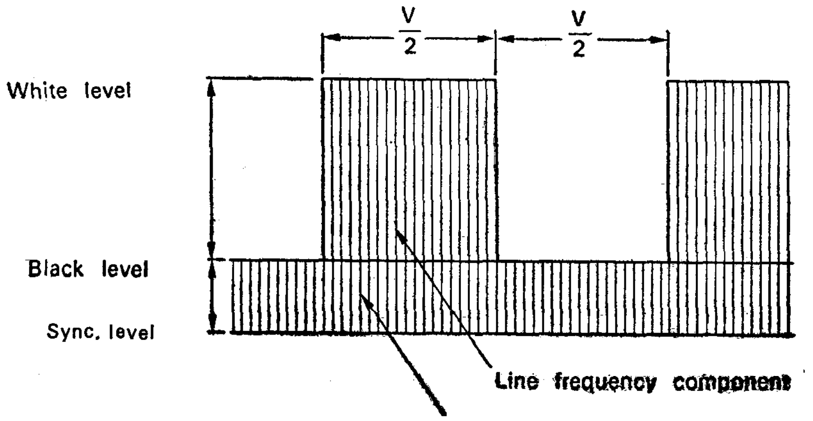
a) Luminance test signal, synchronization pulse omitted when applied to colour system coder.



b) Chrominance test signal.



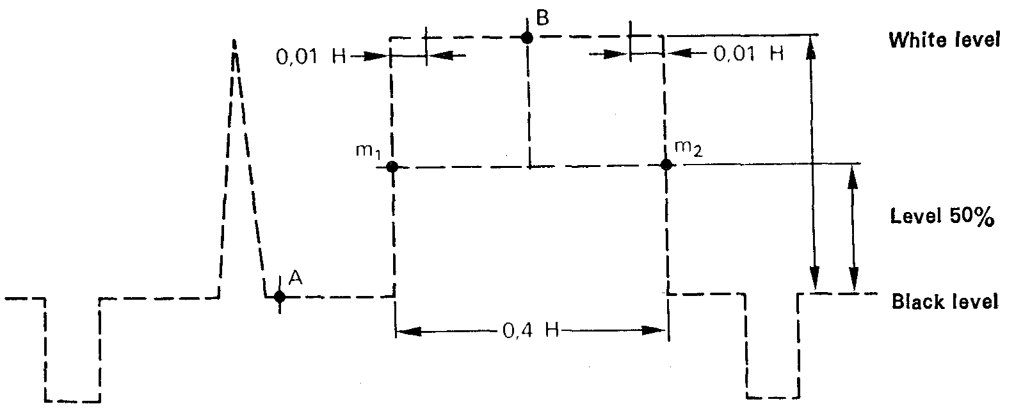
c) Composite test signal formed from (b) and (a) with luminance picture modulation component to 50 percent level.



V = field period
Synchronizing pulses, omitted when applied to colour system coder

d) Field frequency square wave signal.

FIG. 4 WAVEFORMS OF LIMITED SPECTRUM PULSE AND BAR SIGNALS



H = line period
A = point at black level
B = is midpoint measured between m_1 and m_2

FIG. 5 BAR RESPONSE AND PULSE-TO-BAR RATIO

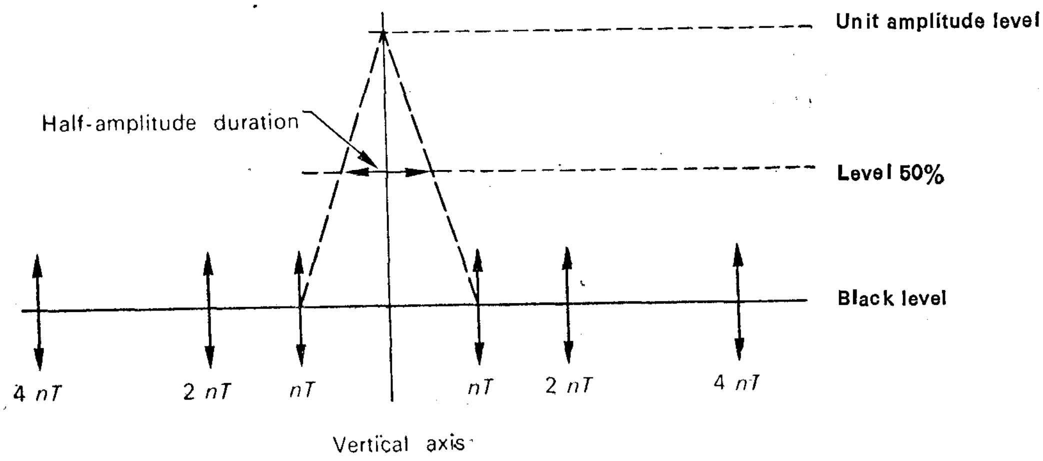


FIG. 6 *nT* PULSE RESPONSE

tude points of the response is measured and expressed is nanoseconds. These values may be expressed in terms of the rating factor K using the expressions given below:

K rating of 2 T pulse half-amplitude duration a in the same unit as T

$$K = \left| \frac{a - 2T}{10\,T} \right|$$

Points on time axis and unit intervals	K *rating as a function of percentage of peak response b*
±1	$K = \left\| \frac{b}{400} \right\|$
±2	$K = \left\| \frac{b}{200} \right\|$
±4	$K = \left\| \frac{b}{100} \right\|$

4.5 2 *T* Pulse/Bar Rating — The oscilloscope is adjusted as shown in Fig. 5 and indicated in **4.3**. The ratio of the amplitude of the 2 T pulse to the amplitude of the 2 T bar response at point B is measured and may be expressed in terms of the rating factor K using the expression given below.

K rating of 2 T pulse to bar ratio expressed as a function of b;

$$K = \left| \frac{100 - b}{4\,b} \right|$$

4.6 Chrominance Sub-carrier Response of Luminance Channel — The oscilloscope is adjusted as in **4.3** using the 2 T pulse and bar signal (Fig. 4A). The composite chrominance pulse and bar signal (Fig. 4C) is then applied and the peak-to-peak excursions of the chrominance sub-carrier in the neighbourhood of point B is measured.

The chrominance sub-carrier response is expressed as the ratio of the peak-to-peak excursions of the chrominance sub-carrier measured as above to the difference between black level and white level.

The measurement shall be repeated with the composite chrominance pulse and bar signal picture modulation reduced by 50 percent and half the difference between black level and white level used in expressing the result.

4.7 Composite Chrominance Sub-carrier 2 T_c Pulse Response of Luminance Channel — The composite chrominance 2 T_c pulse and bar signal is applied as picture modulation. The oscilloscope is adjusted as shown in Fig. 7 such that the sweep velocity corresponds to the time scale indicated, the black level of the response coincides with the horizontal axis, the peak of the response corresponds to unit-amplitude and the half-amplitude points are symmetrically disposed about the vertical axis.

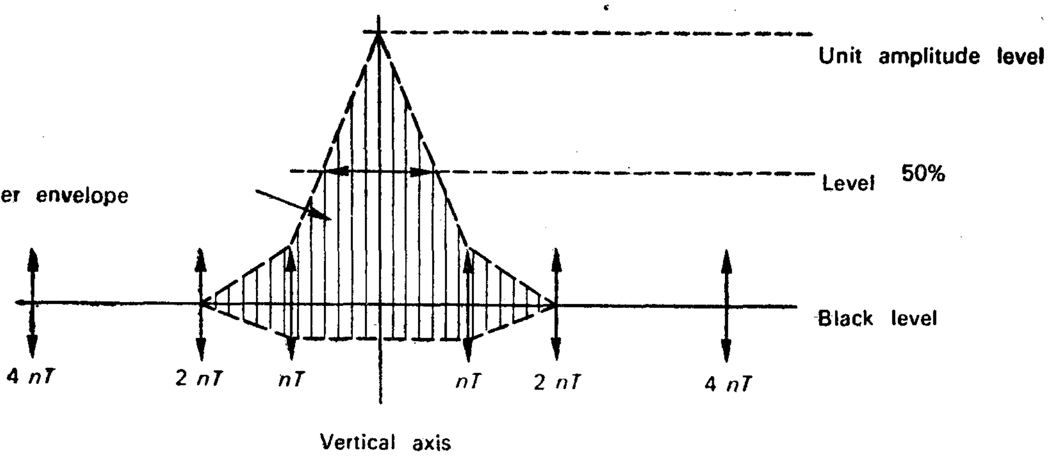


FIG. 7 RESPONSE OF LUMINANCE CHANNEL TO A CHROMINANCE CARRIER PULSE

The maximum excursions of the envelope are measured at the indicated points on the horizontal axis and expressed as a percentage of the peak response.

4.8 Field Frequency Square-wave Response — The oscilloscope is adjusted as shown in Fig. 8 so that the half-amplitude points of the bar transitions coincide with points m_1 and m_2 and so that the mid-points of the positive and negative excursions correspond with points A and B. The display is adjusted so that points A and B correspond to the unit amplitude, the synchronizing pulse being ignored.

The maximum departure b of the bar amplitude above and below the unit-amplitude level B, between points 0·01 V from, the half-amplitude points of each transition, are measured and expressed as a percentage of unit-amplitude (V is the duration of one vertical field). The results may be expressed in terms of the rating factor K using the expression given below:

K rating of field frequency square-wave response expressed as a function of b:

$$K = \left|\frac{b - 100}{2}\right|$$

5. MODULATION-FREQUENCY/RESPONSE CHARACTERISTIC, CHROMINANCE CHANNEL (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

5.1 Definition — The chrominance channel modulation-frequency/response characteristic represents the amplitude of the chrominance signal picture modulation at the picture tube electrodes as a function of the modulation frequency.

5.2 Method of Measurement — The chrominance channel modulation-frequency/response characteristic in the range from 100 kHz upwards is measured on a representative channel chosen from those in which the receiver is designed to operate. The receiver must be tuned in accordance with 2 of IS : 4545 (Part 2) - 1983*.

The receiver is adjusted to provide standard video output voltage. A suitable test pattern signal is then applied and the receiver adjusted to provide optimum colour decoding.

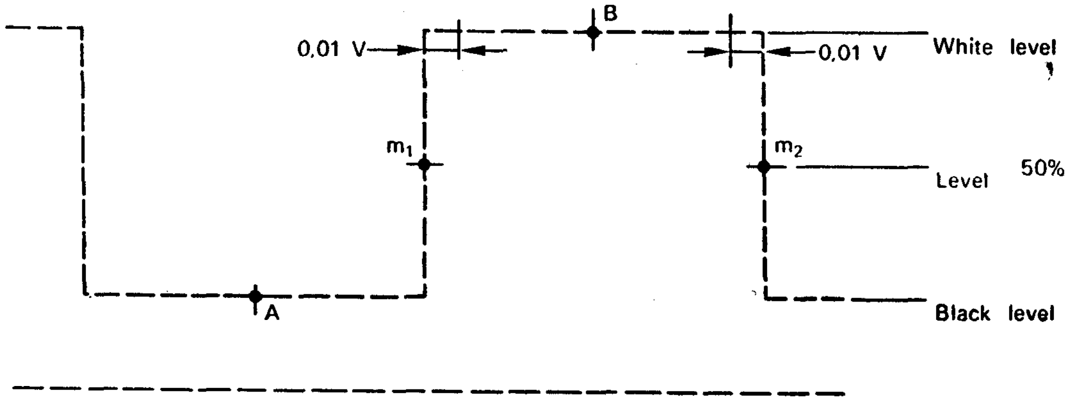


FIG. 8 FIELD RATE SQUARE WAVE RESPONSE

---

*Methods of measurement on receivers for television broadcast transmissions : Part 2 Tuning properties and general measurements (*first revision*).

The radio-frequency carrier is modulated with the output signal from the appropriate colour system coder having inputs for the three primary colours and an independent luminance channel. A 50-percent constant level grey pedestal is applied to the luminance channel input and sine-wave picture modulation swinging over the ranges 25 to 75 percent and 40 to 60 percent, is applied in turn to the three primary colour inputs of the coder.

The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983* so that noise effects do not influence measurement.

An oscilloscope is connected in place of the picture tube, to each appropriate primary colour or colour difference output signal in turn, in such a manner that the frequency response of the video circuits is unchanged and the electrodes continue to have suitably applied potentials.

The level of the picture modulation is kept constant, the frequency being varied between approximately 100 kHz at the nominal system upper limit of the chrominance passband. The peak-to-peak amplitude of the picture modulation to either side of the mid-value displayed on the oscilloscope is plotted as a function of the modulation-frequency. Measurements are carried out at the two levels of picture modulation defined above.

Measurement may be carried out by means of a video sweep generator instead of the sine-wave signal generator, the result being displayed on a suitable indicator.

5.3 Graphic Representation — The amplitude of the sinusoidal component of the picture modulation waveform displayed on the oscilloscope is plotted as a function of the modulation frequency. When a swept signal is used, the result may be recorded photographically. The frequency scale on the abscissa and the amplitude scale on the ordinate may be either linear or logarithmic (*see* Fig. 9).

6. LINEAR WAVEFORM RESPONSE, CHROMINANCE CHANNEL (NOT APPLICABLE TO MONOCHROME TV RECEIVER)

6.1 Definition — The linear waveform response, chrominance is the wave shape measured at the appropriate picture tube electrodes when applying the stated limited spectrum test signals to the colour system coder providing the video signal to radio-frequency modulator. The results are expressed as a percentage of the difference between black level and the signal level occurring in the appropriate channel corresponding to unit-amplitude. A rating factor K may also be used in some cases; this allows for the differing subjective effect of various distortions.

Alternatively, the results may be presented by photographic records of the various waveforms.

Four types of response measurement are described indicating the frequency and group-delay response over the chrominance passband and the chrominance carrier frequency band. They are:

a) line rate bar response,

b) pulse response,

c) pulse-to-bar ratio, and

d) field frequency square-wave response.

6.2 Method of Measurement — The responses (a), (b), (c) and (d) to the appropriate signals are measured on a representative range of the channels in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983*. The receiver is adjusted to provide standard video output voltage. A test pattern is then applied and the receiver adjusted to provide optimum decoding. The radio-frequency carrier is modulated with the output signal from the appropriate colour system coder having inputs for the three primary colours and an independent luminance channel. A 50-percent grey level constant pedestal is applied to the luminance channel input and picture modulation corresponding to a 2 T_c pulse and bar and a field rate square-wave is applied, in turn, to the three primary colour inputs of the coder at 55 percent and 30 percent of the maximum system level. Suitable networks for band-limiting pulse and bar signals are shown in Fig. 3. The waveforms of the test signals are shown in Fig. 4, and T_c is as defined in **4.2**. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network.

Where the system in use requires that the signal be pre-corrected for receiver group delay characteristic, this pre-correction shall be included in the signal generator.

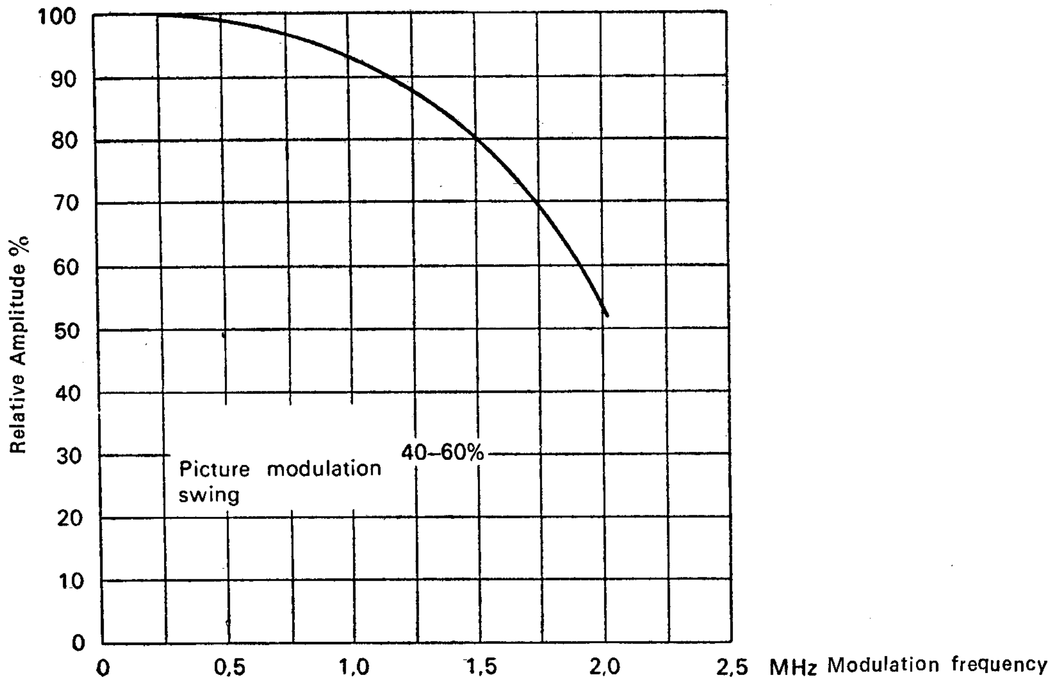
The input level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983† so that noise effects do not influence measurement. An oscilloscope is connected in place of

---

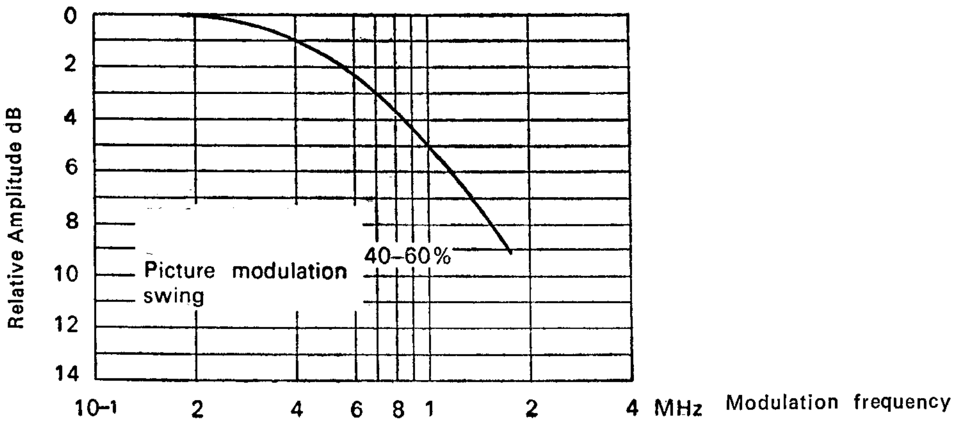
*Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurement (*first revision*).

†Methods of measurement on receivers for television broadcast transmission:s Part 5 Sensitivity (*first revision*).



a) Linear scale



b) Logrithmic scale

FIG. 9 EXAMPLES OF MODULATION FREQUENCY/CHROMINANCE CHANNEL RESPONSE

the picture tube to each appropriate primary colour or colour difference output signal in turn, in such a manner that the frequency response of the video circuits is unchanged and the electrodes continue to have suitably applied potentials.

6.3 2 T_c Bar Response — The oscilloscope is adjusted as shown in Fig. 5 so that the half-amplitude points of the bar transitions coincide with points m_1 and m_2. Points A at black level or the grey pedestal level and B at the mid-point of the bar are set at unit-amplitude. The maximum departure of the bar from unit-amplitude between points extending to $\frac{H}{30}$ from the half-amplitude points of each transition is measured and expressed as a percentage b of unit-amplitude. The result may be expressed in terms of the rating factor K using the expression given below:

K rating of 2 T_c bar response expressed as a function of b:

$$K = | b - 100 |$$

6.4 2 T_c Pulse Response — The oscilloscope is adjusted as shown in Fig. 6 such that the sweep velocity corresponds with the time scale indicated, the black level or grey pedestal level of the response coincides with the horizontal axis, the peak of the response corresponds with unit-amplitude and the half-amplitude points of the response are symmetrically disposed about the vertical axis. The amplitude of the signal is measured at the indicated points on the horizontal axis and expressed as a percentage of the peak response. The difference in time between the half-amplitude points of the response is measured and expressed in nanoseconds.

These values may be expressed in terms of the rating factor K using the expressions below:

$$K = \left| \frac{a - 2\,T_c}{10\,T_c} \right|$$

(a and T_c are expressed in the same units).

Points on Time Axis in Unit Intervals	K *Rating as a Function of Percentage of Peak Response* b
±1	$K = \left\| \frac{b}{400} \right\|$
±2	$K = \left\| \frac{b}{200} \right\|$
±4	$K = \left\| \frac{b}{100} \right\|$

6.5 2 T_c Pulse/Bar Rating — The oscilloscope is adjusted as shown in Fig. 5 and indicated in **6.3**. The ratio of the amplitude of the 2 T_c pulse to the amplitude to the 2 T_c bar response at a point B is measured and expressed in terms of the rating factor K using the expression given below:

K rating of 2 T_c pulse/bar ratio expressed as a function of b:

$$K = \left| \frac{100 - b}{4\,b} \right|$$

6.6 Field Frequency Square-Wave Response — The oscilloscope is adjusted as shown in Fig. 8 so that the half-amplitude points of the bar transitions correspond with points m_1 and m_2 and so that the mid-points of the positive and negative excursions correspond with points A and B. The display is adjusted so that points A and B correspond to the unit-amplitude, the synchronizing pulses and the grey pedestal, if either are present, being ignored. The maximum deviations above and below the unit-amplitude level up to points 0·01 V from the half-amplitude point of each transition are measured and expressed as a percentage of unit-amplitude. The result may be expressed in terms of the rating factor K using the expression given below.

K rating of field frequency squarewave response expressed as a function of b:

$$K = \left| \frac{b - 100}{2} \right|$$

6.7 Presentation of Results — Since significant differences in the responses of the colour difference channels can give rise to errors in colour transitions, the response to a given test signal may be superimposed on a single graph with those relating to the various colour difference channels, being suitably identified in order to indicate the presence of such differences.

7. BLACK LEVEL AND ITS STABILITY

7.1 Introduction — Black level is the television signal level during the active line period in the absence of picture modulation. It applies to the luminance signal, the individual primary colour signals, and the individual colour difference signals. Measurements of the luminance generated by the picture tube when the signal is at black level may be carried out or of the equivalent signal voltage level at the picture tube electrodes. This clause deals with measurements of the variation of the voltage corresponding to black level at the picture tube electrodes with respect to time, temperature, supply voltage, input signal level and between monochrome and colour operation. It must be borne in mind, when interpreting the following electrical measurements, that the picture tube luminance corresponding to black level may be influenced by changes in supply potentials and voltages or ancillary electrodes of the picture tube.

7.2 Voltage Corresponding to Black Level — The voltage corresponding to black level is the potential on a controlling electrode of the picture tube relative to ground potential or the potential of a supply rail. All guns of a multigun colour picture tube are to be measured individually. Where more than one picture tube electrode is modulated with the same signal or with associated signals, the difference in potential between the two controlling electrodes measured with the signal at black level, is the voltage corresponding to black level.

7.3 Variation of Black Level with Time — If no other influence is present, the variation of the voltage corresponding to black level with time is mainly due to the temperature dependence of the component characteristics and the internal heating of the receiver. It is the change in the voltage corresponding to black level expressed as a percentage of the difference between black level and white level, as a function of time.

7.4 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted to be between those levels defined in **5** and **15** of

---

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

IS : 4545 (Part 5) - 1983* so that noise effects do not influence measurements. The radio-frequency signal is modulated with a selectably monochrome or colour video signal having picture content at black level. An oscilloscope is connected to the appropriate picture tube electrode or electrodes and the variation of the voltage corresponding to black level measured at specific time intervals under constant supply voltage, ambient temperatue and relative humidity without touching the receiver controls. If applicable, it is recommended that the measurements be repeated at the lowest and highest values of ambient temperature to be encountered in practice.

Measurements may also be repeated for a range of ambient temperatures. Measurements shall be carried out with both monochrome and colour signals and in the case of a colour receiver, for the electrodes or groups of electrodes generating the individual primary colour images. When the picture tube has a number of electrodes influencing the sensitivity of the main control electrodes, variations in the operating potentials of these electrodes shall also be measured under the various conditions and any significant changes recorded with the results.

7.5 Period of Initial Variation of Black Level — The period of initial variation of black level is the time elapsing between initial switching on and the establishment of a condition in which the voltage corresponding to black level stays within a specified tolerance. The initial variation of black level is the value of the variation of the voltage corresponding to black level and the difference between the highest and lowest voltages corresponding to black level expressed as a percentage of the difference between black level and white level occurring in this period.

7.6 Method of Measurement — Before commencement of the measurements, the receiver shall be switched off for a sufficiently long period for all parts of the receiver to attain approximately the test room temperature.

The duration and extent of the initial variation of black level shall be derived from a series of measurements from the moment of switching on, but measurements of the voltage corresponding to black level begin as soon as these are performable.

The signals used for measurement, their application to the receiver and the measurement intrumentation are as in **7.4**. Due to the necessity of commencing measurements at room temperature, arrangements may be made to carry out various measurements simultaneously or to restrict the number of measurements to those considered the most significant.

7.7 Presentation of Results — The variation in the voltage corresponding to black level expressed as a percentage of the difference between black level and white level is plotted as a function of time in a curve having as abscissa, time in minutes on a logarithmic scale and as ordinate, the change of voltage. As reference, the voltage corresponding to black level at either 1 minute or 1 hour after initial switching on may be chosen. An example of curve showing the variation of voltage corresponding to black level as a function of time is shown in Fig. 10.

7.8 Black Level as a Function of Supply Voltage — A variation in the supply voltage may result in a change of the voltage corresponding to black level. The signals used for measurements and the instrumentation are those of **7.4**. The voltage

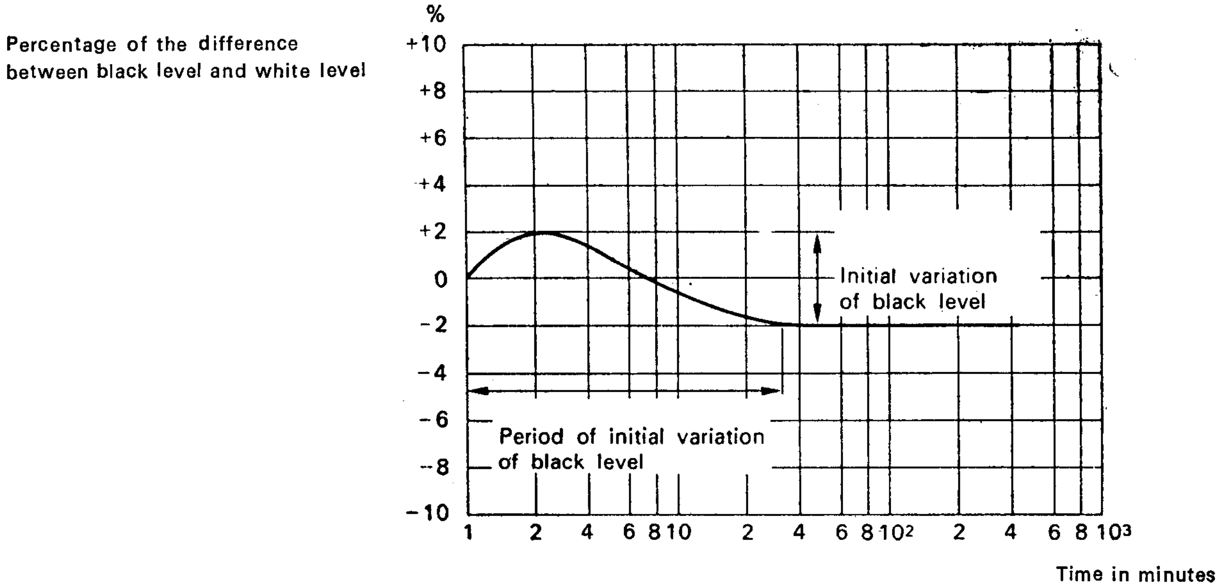


FIG. 10 EXAMPLE OF VARIATION OF VOLTAGE CORRESPONDING TO BLACK LEVEL AS A FUNCTION OF TIME

---

*Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

corresponding to black level is measured as defined in **7.2** as a function of supply voltage, the latter being varied within the appropriate limits as selected from those laid down in **6** of IS : 4545 (Part 1)-1983*. This measurement shall not be performed during the period of initial variation of black level. When the picture tube has a number of electrodes influencing the sensitivity of the main control electrodes, variation in the operating potentials of these electrodes shall also be measured and any significant changes recorded with the results.

7.9 Presentation of Results — Curves representing the voltage corresponding to black level as a function of the supply voltage are plotted with the voltage variation as ordinate expressed as a percentage of the difference between black level and white level on a linear scale. The supply voltage variation is expressed as a percentage on a linear horizontal scale. An example of a curve showing the variation of the voltage corresponding to black level as a fuction of supply voltage is shown in Fig. 11.

7.10 Black Level as a Function of Input Signal Level — A variation in the input signal may result in a change of the voltage corresponding to black level. The signals used for measurement and the instrumentation are those of **7.4**. The voltage corresponding to black level is measured as defined in **7.2** as a function of input signal, the latter being varied within the appropriate limits over the full range of the values in accordance with **9** of IS : 4545 (Part 1)-1983*. This measurement shall not be performed during the period of initial variation of black level. When the picture tube has a number of electrodes including the sensitivity of the main control electrodes, variations in the operating potentials of these electrodes shall also be measured and any significant changes recorded with the results.

7.11 Presentation of Results — Curves representing black level as a function of input signal level are plotted with the variation of the voltage corresponding to black level expressed as a percentage of difference between black level and white level as ordinate on a linear scale. The recommended reference value depending on the receiver sensitivity being that contained with an input signal level of −50 dB (mW). The input signal is expressed in decibels as the abscissa on a linear scale. An example of a curve showing variations of voltage corresponding to black level as a function of input signal level is shown in Fig. 12.

7.12 Change to Black Level Between Colour and Monochrome Operation — Due to the presence of a chrominance synchronizing signal such as a reference carrier burst or the presence of the chrominance carrier itself in colour systems employed frequency modulation of the chrominance carrier, differences in black level can occur between monochrome and colour operation. It applies to the luminance black level and to both the individual primary colour signal and the individual colour difference signal black levels.

7.13 Method of Measurement — The signals used for measurement and the instrumentation are those of **7.4**. The voltage corresponding to black level is measured as defined **7.2** first for monochrome operation and then for colour operation. Measurements are carried out at the extreme positions of any colour saturation control as well as at the position giving optimum decoding.

8. DC COMPONENT DISTORTION LUMINANCE CHANNEL

8.1 Definition — The distortion of the dc component of the luminance signal is the shift of the voltage corresponding to black level on or between the control electrode or electrodes of the picture tube due to a change in picture luminance signal level.

8.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2)-1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. When a vision signal interference limiter control is provided, it shall be set to have least effect upon the picture. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network.

The input signal level is adjusted between those level defined in **5** and **15** of IS : 4545 (Part 5)-1983† so that noise effects do not influence measurement. Measurements are also carried out at high and low signal levels as defined respectively in **5** and **15** of IS : 4545 (Part 5)-1983† (the low signal level being, however, such that measurement accuracy is not impaired by noise). The radio-frequency signal is modulated with a video signal corresponding, successively to black level 50 percent of white level and white level. The signals at 50 percent white level and white level shall include a small area at black level (*see* Fig. 13A).

---

*Methods of measurement on receivers for television broadcast transmissions: Part 1 General considerations (*first revision*).

*Method of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

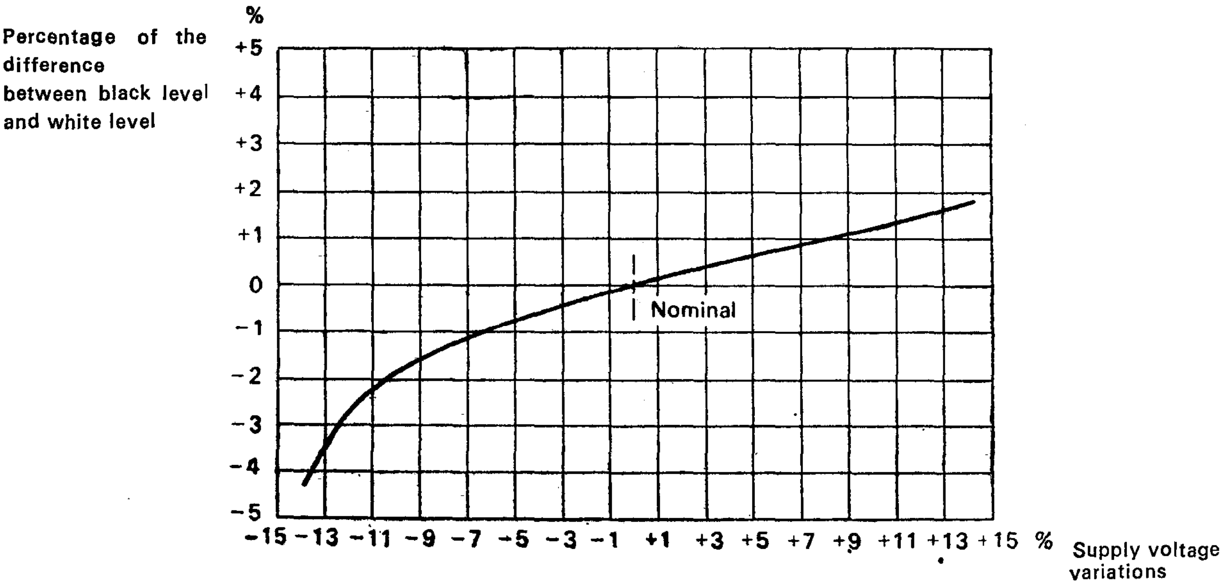


FIG. 11 EXAMPLE OF VARIATION OF CORRESPONDING TO BLACK LEVEL AS A FUNCTION OF THE SUPPLY VOLTAGE

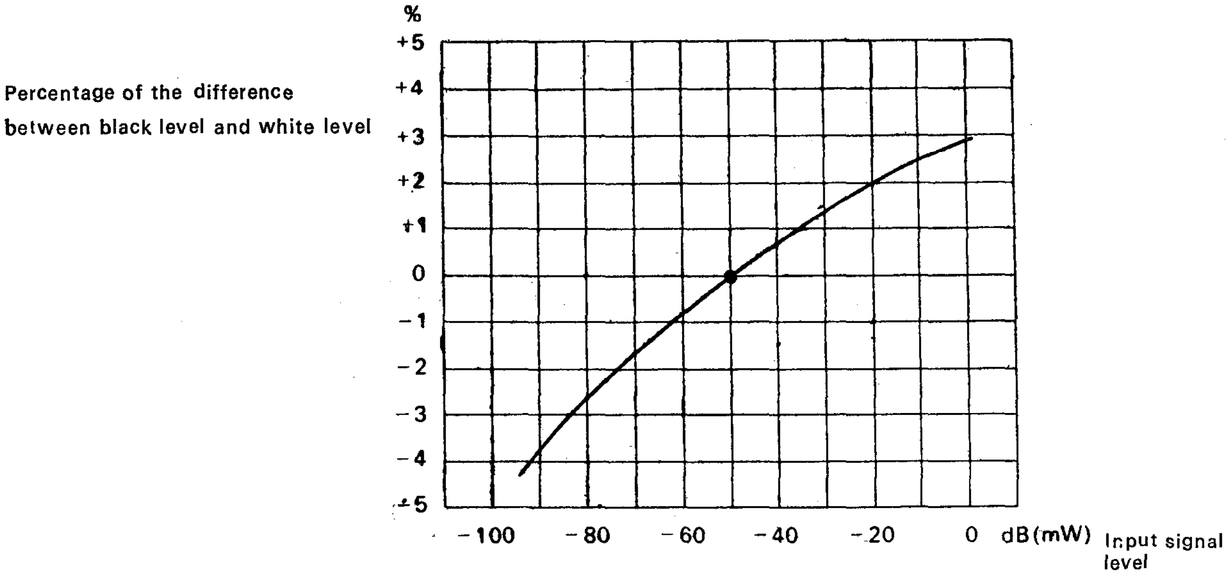
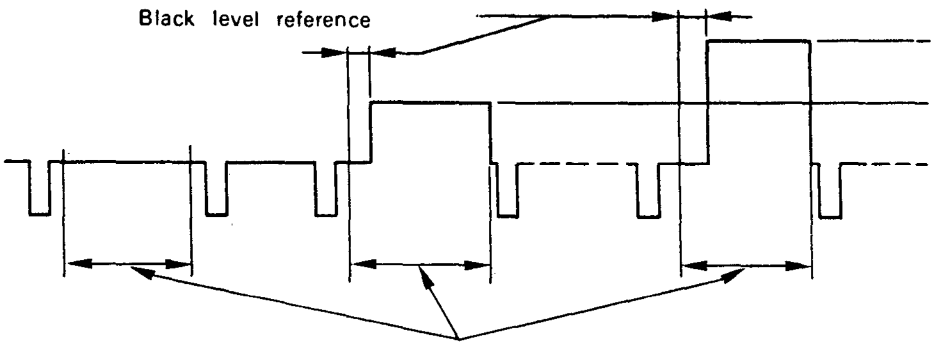


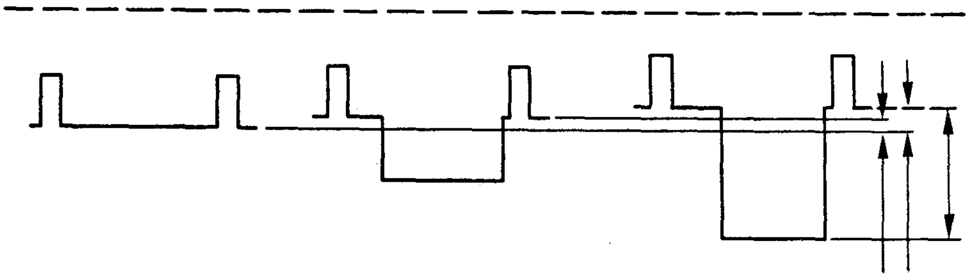
FIG. 12 EXAMPLE OF VARIATION OF CORRESPONDING TO BLACK LEVEL AS A FUNCTION OF THE INPUT SIGNAL LEVEL

An oscilloscope is connected to the appropriate picture tube electrode or electrodes and the voltage corresponding to black level is measured at the control electrodes or electrode of the picture tube. The shift in the voltage corresponding to black level for the three picture signal conditions is expressed as a percentage of the difference in potential between black level and white level for standard video output voltage (*see* Fig. 13B).

In a colour receiver, each electrode driven by the luminance signal either directly or as a component of a primary colour signal, is to be measured. Where both grid and cathode of a picture tube electron gun have a luminance signal or luminance signal derived component applied, a differential oscilloscope measurement shall be made between the appropriate electrodes. Care shall be taken in making measurements to observe whether any distortions to the dc component are due to beam current limiting arrangements. Any such effects should be noted in the results. When the picture tube has number of electrodes influencing the sensitivity of the main control electrodes, variations in the operating potentials of those electrodes shall also be



13A Input Signal for dc Component Measurements



13B Video Output Signal for dc Component Measurement

FIG. 13 MEASUREMENT OF D.C. COMPONENT DISTORTION IN THE LUMINANCE CHANNEL

measured under various conditions and any significant changes recorded with the results.

9. DC COMPONENT DISTROTION, COLOUR DIFFERENCE SIGNAL (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

9.1 Definition — The distortion of the dc component of the colour difference signals, where these are applied to the picture tube electrodes separately from the luminance signals, is the shift of the voltage corresponding to colour difference signal black level on the control electrode or electrodes of a given gun of the picture tube due to a change in picture-colour difference signal level.

9.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with IS : 4545 (Part 2)-1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding.

The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in 5 and 15 of IS : 4545 (Part 5) - 1983† so that noise effects do not influence measurement.

Measurements are also carried out at low signal levels as defined in 5 of IS : 4545 (Part 5)-1983*, the low signal level being, however, such that measurement accuracy is not impaired by noise. The radio-frequency signal is modulated by the output of a suitable colour system coder. Input signals corresponding successively to black level, 50 percent of peak level and peak level, with the latter two including a small area at black level of the primary colour signals, are applied, in turn, to the red , blue, green, blue and green, red and green, and red and blue primary colour inputs of the coder (*see* Fig. 14 A).

An oscilloscope is connected to the appropriate picture tube electrodes in turn and in each case the voltage corresponding to the colour difference signal black level is measured for the three signal conditions applied in the six combinations to the coder inputs. The change in the voltage expressed as a percentage of the difference in potential between black level and the level corresponding to the maximum level as measured when the input signal is a full amplitude, full purity colour bar signal with the white bar at white level. Care shall be taken in making measurements to observe whether any effects are due to beam current limiting arrangements. Any such effects shall be noted in the results (*see* Fig. 14B and 14C).

10. DC COMPONENT DISTORTION, PRIMARY COLOUR SIGNALS (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

10.1 Definition — DC component distortion of the primary colour signals is the shift of voltage

---

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmission: Part 5 Sensitivity (*first revision*).

*Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

corresponding to black level on the control electrode of a picture tube, to which a primary colour singal is applied, due to a change in primary colour signals level.

10.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. the receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2)-1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding.

The radio-frequeney signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network.

The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5)-1983† so that noise effects do not influence measurement. Measurements are also carried out at low signal levels as defined in **5** of IS : 4545 (Part 5)-1983† the low signal level being, however, such that measurement accuracy is not impaired by noise. The radio-frequency signals is modulated by the output of a suitable colour system coder. Input signal corresponding successively to black level, 50 percent of peak level and peak level, with the latter two including a small area at black level of the primary colour signals are applied, in turn, to the red, blue, green, blue and green, red and green, and red and blue primary colour inputs of the coder (*see* Fig. 14A).

An oscilloscope is connected to the appropriate picture tube electrodes in turn and in each case the voltage corresponding to the primary colour signal black level is measured for the three signal conditions applied in six combinations to the coder inputs. The change in the voltage corresponding to black level for the various conditions is expressed as a percentage of the standard video output voltage. Care shall be taken in making measurements to observe whether any distortions to the dc component are due to beam current limiting arrangements. Any such effects shall be noted in the results. When the picture tube has a number of electrodes, influencing the sensitivity of the main control electrodes, variations in operating potentials of these electrodes shall also be measured under the various conditions and any significant changes recorded in the results (*see* Fig. 14D).

11. ERRORS OF CHROMINANCE SIGNAL DEMODULATION ANGLE (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

11.1 Definition — Three aspects of the chrominance signal demodulation measured are:

a) the demodulation angles of the carrier chrominance signal,
b) the delayed carrier chrominance signal phase matching, and
c) the amplitude matching of delayed and undelayed carrier chrominance signals.

11.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2)-1983* and is adjusted to provide a standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5)-1983† so that noise effects do not influence measurement. Measurements are also carried out at low signal levels as defined in **5** of IS : 4545 (Part 5)-1983†, the low signal level being, however, such that the measurement accuracy is not impaired by noise.

11.3 Errors of Chrominance Signal Demodulation Angle — The radio-frequency signals modulated by the output of a suitable colour system coder, the input signals being colour bars occurring on alternate lines, the intermediate lines being at black level.

An oscilloscope is connected to the appropriate point in the circuit where the $R - Y$ signals may be observed. The $R - Y$ modulation component is switched off at the coder.

The mean phase of the chrominance carrier reference bursts is adjusted to achieve a minimum response averaged over pairs of lines. The value and sign of the necessary shift are recorded as the $R - Y$ error. The mean phase of the reference bursts where this has been shifted is now returned to nominal and the oscilloscope connected to a suitable point to observe the $B - Y$ signal. The $R - Y$ modulation at the coder is now switched on and the $B - Y$ modulation switched off. The mean phase of the chrominance carrier reference bursts is adjusted

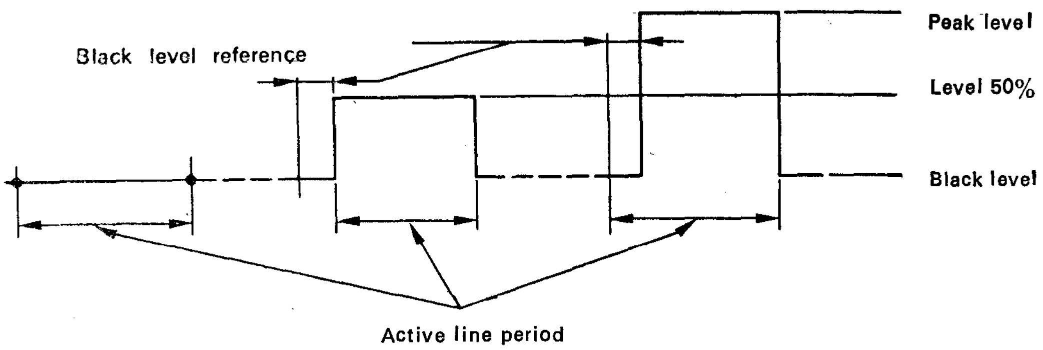
---

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

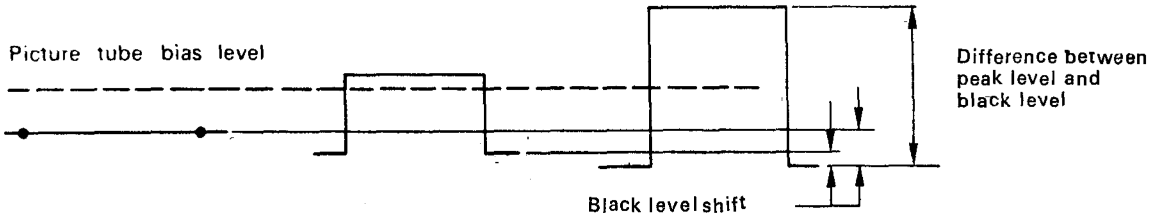
†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

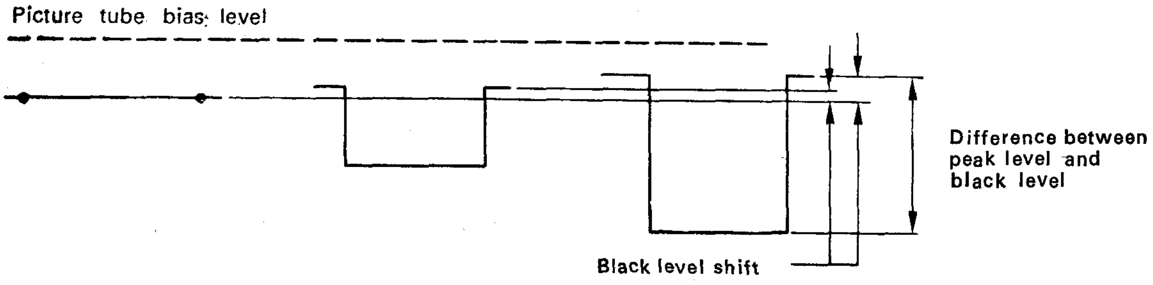
†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).



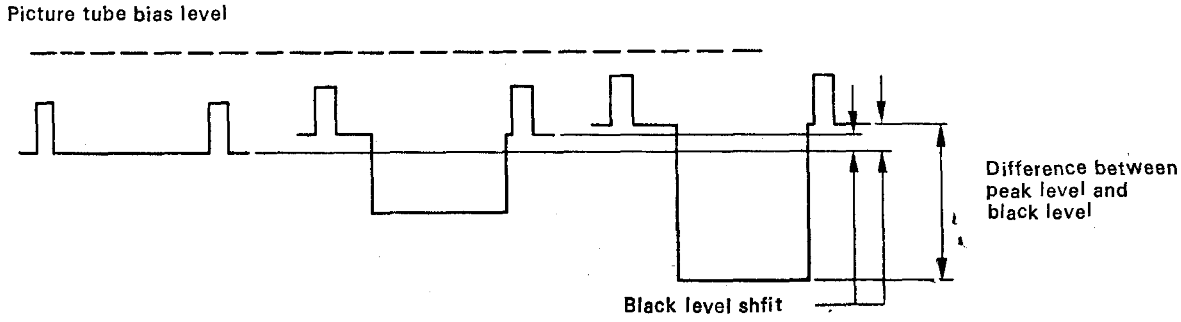
14A Coder Input Signals



14B Colour Difference Output Signal for Positive Polarity



14C Colour Difference Output Signal for Negative Polarity



14D Primary Colour Output Signal

FIG. 14 MEASUREMENT OF D.C. COMPONENT DISTORTION COLOUR DIFFERENCE SIGNALS AND PRIMARY COLOUR SIGNALS

at the coder to give minimum response averaged over pairs of lines. The value and sign of this phase shift is recorded as the $B - Y$ error.

11.4 Delayed Chrominance Carrier Signal Phase Matching — The measurement is as defined in **11.3** when measuring the $R - Y$ error. An error indirect and delayed path phase matching will result in a different adjustment at the coder of the chrominance carrier reference burst mean phase to achieve minimum response on each of the adjacent lines in time. This difference in phase shift is measured observing the $R - Y$ output. The differences expressed either in degrees of chrominance carrier phase or converted into time in nanoseconds is recorded as the error.

11.5 Amplitude Matching of Delayed and Direct Chrominance Carrier Signal — The test set-up is as defined in **11.3**, the oscilloscope being connected to observe the $R - Y$ signal. The $B - Y$ modulation of the coder is switched off and the amplitude of the $R - Y$ signal measured on adjacent lines in time. The amplitude matching error of delayed and direct signals is the ratio of the smaller to the larger expressed as a percentage.

12. EFFECTS OF PHASE DISTORTION ON INCOMING SIGNAL FOR SMALL PICTURE AREAS (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

12.1 Definition — Chrominance signal sideband asymmetry in the receiver will cause the decoder to respond differently to transients as compared to large areas of the picture when there is distortion of the phase relationship between the chrominance carrier reference bursts and the carrier chrominance picture signal as receiver. Hanover blind effects may arise on transitions and the transient response may be degraded.

12.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2)-1983* and is adjusted to provide a standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter, as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5)-1983† so that noise effects do not influence measurement. Measurements are also carried out at low signal levels as defined in **5** of IS : 4545 (Part 5) - 1983* the low signal level being, however, such that the measurement accuracy is not impaired by noise.

The radio-frequncy signal is modulated by the output of a suitable colour system coder having inputs for the three primary colours and an independent luminance channel. A 50 percent grey level constant pedestal is applied to the luminance channel and picture modulation corresponding to a 2 T_c pulse and bar is applied to the three primary colour inputs of the coder at 55 percent and 30 percent of the maximum system level. Suitable networks for band-limiting pulse and bar signals are shown in Fig. 3. The waveforms of the test signals are shown in Fig. 4 and T_c is as defined in **4.2**.

An oscilloscope is connected in place of the picture tube to each appropriate primary colour or colour difference output signal, in turn, in such a manner that the frequency response of the video circuits is unchanged. The 2 T_c pulse/bar ratio is measured as indicated in **6.5** and the peak-to-peak amplitude of the pulse is measured. The mean phase of the reference chrominance carrier burst at the coder is advanced 30° in phase from the nominal condition. The pulse to bar ratio is again measured as above and the peak-to-peak value of any Hanover blind effect occurring on the peak of the pulse is also measured. These measurements are then repeated with the mean phase of the reference chrominance carrier burst at the coder retarded 30° in phase.

12.3 Presentation of Results — Results are tabulated for the three primary colour signals and in each case, for the three conditions of phase and two of amplitude showing the pulse/bar amplitude ratios and the changes in the amount of Hanover blind effects on the pulse, as shown in Fig. 15A and 15B.

13. LUMINANCE/CHROMINANCE DELAY INEQUALITY (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

13.1 Definition — Luminance/chrominance delay inequality is a measure of the error in relative timing of the luminance and chrominance components of the primary colour signals or the equivalents saparate luminance and chrominance signals applied to the picture tube.

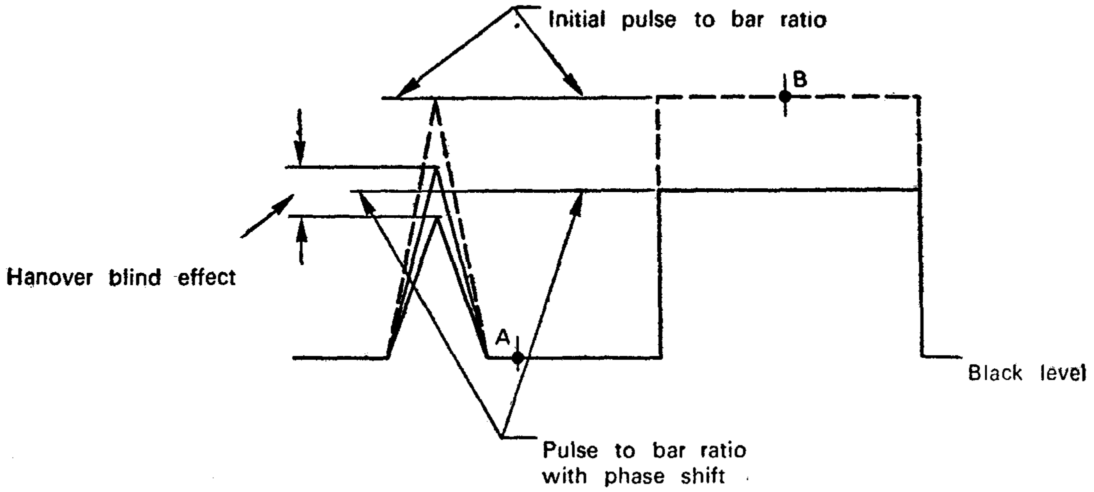
13.2 Method of Measurement — Measurement is carried out on a respresentative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983* and is adjusted to provide standard video output voltage. A test patttern is applied and the receiver adjusted for

---

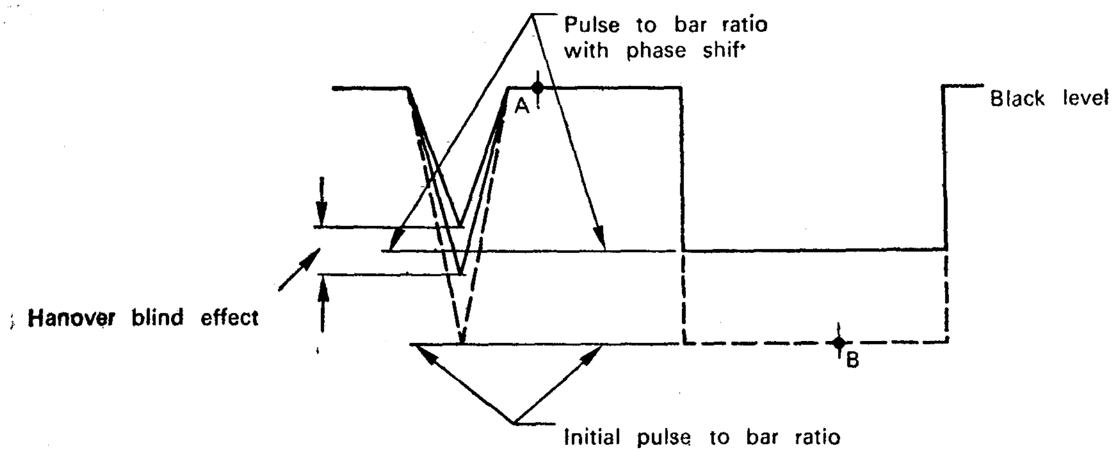
*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

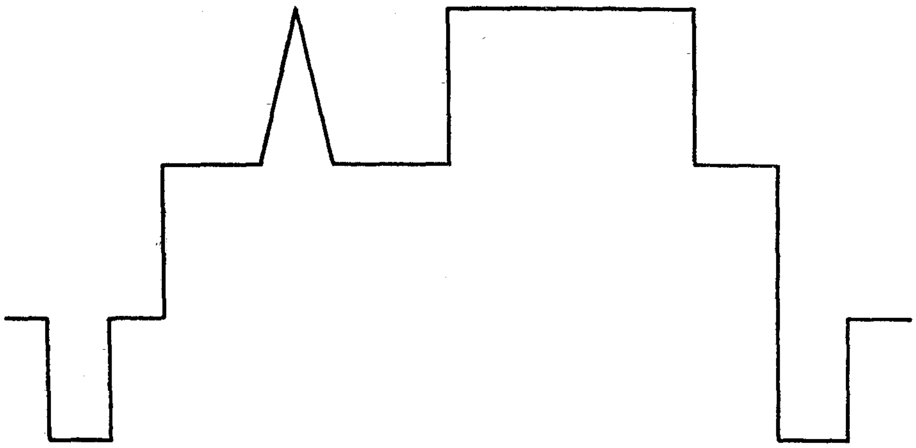
*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).



15A Colour Difference Signal Measurement, Positive Polarity

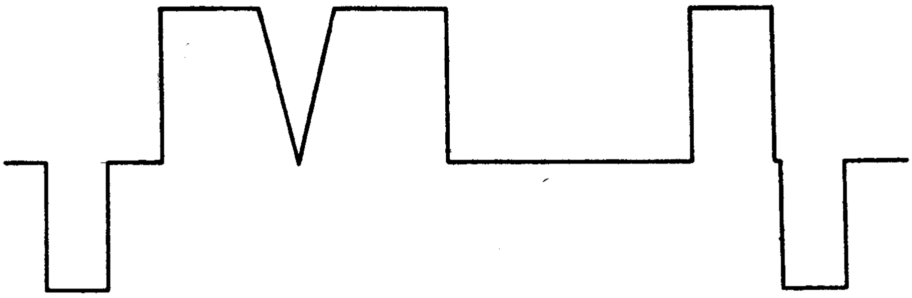


15B Colour Difference Signal Measurement, Negative Polarity



15C Primary Colour Signal Measurement, Positive Polarity

FIG. 15 DISTORTION OF SIGNAL PICTURE AREAS, PAL SYSTEM



15D Primary Colour Signal Measurement, Negative Polarity

FIG. 15 DISTORTION OF SMALL PICTURE AREAS, PAL SYSTEM

optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5)-1983* so that noise effects do not influence measurement. The radio-frequency signal is modulated by the output of a suitable colour system coder having inputs for the three primary colours and an independent luminance channels. The input signals of the coder consist of 2 T_c pulse and bar signals applied in the proportions indicated below, according to the primary colour channel being measured.

Channel to be Measured	Coder Inputs in Percentage of Maximum Value			
	R	*G*	*B*	*Y*
R	0	75	75	53
B	75	75	0	67
G	75	0	75	31
R	0	30	30	21
B	30	30	0	27
G	30	0	30	12

Three primary colour channels are measured in turn at the two levels defined above by connection of an oscilloscope in place of the picture tube to the primary colour output in such a manner that the frequency response of the video circuits is unchanged. Where luminance and colour difference components are applied in separate picture tube electrodes, a differential oscilloscope shall be used to give an indication of the primary colour signals.

In the case of each primary colour channel, the appropriate input signals to the coder are applied and the receiver chrominance channel gain control adjusted to nullify the bar component of the pulse and bar signal.

Where the system in use requires that the signal be pre-corrected for receiver group delay characteristic, this pre-correction shall be included in the signal generator.

Where there is a luminance/chrominance timing error, the pulse component will not disappear entirely but will leave a residual sinusoidal disturbance. Where this sinnsoidal distbabance commences in the direction of white level, the chrominance channel is delayed relative to luminance and when in the other direction, luminance is delayed relative to chrominance. The chrominance component is switched off and the amplitude of the pulse measured. The chrominance component is then switched on and the peak-to-peak magnitude of the sinusoidal disturbance is measured. These values are used in the formula below to determine the magnitude of the luminance/chrominance timing error. Typical resulting waveforms are shown in Fig. 16.

$$\tau = \frac{2\,T_c\,A}{\pi\,B}$$

where

τ = the magnitude of the delay inequality,
T_c = as defined in **4.2**,
A = peak-to-peak amplitude of sinusoidal disturbance, and
B = amplitude of luminance channel pulse alone.

13.3 Presentation of Results — The results are tabulated for the three primary colour channels at the two stated levels showing the magnitude and sign of the relative timing error between the luminance and chrominance components.

14. $G - Y$ SIGNAL MATRIXING ERROR (NOT APPICABLE TO MONOCHROME TV RECEIVERS)

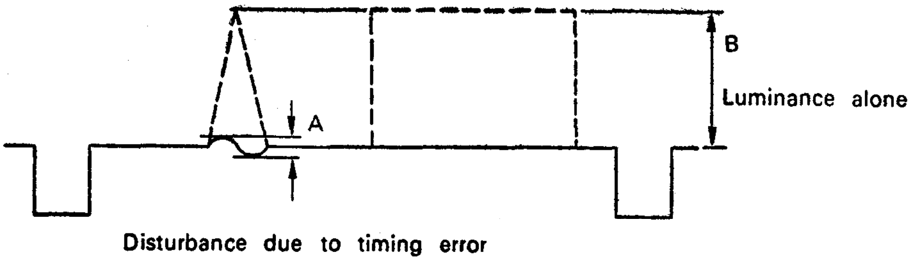
14.1 Definition — Where the $G - Y$ signal is obtained by matrixing proportions of $R - Y$, and $B - Y$, this measurement defines the deviation of these proportions from the nominal value.

14.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 5) -1983* and is adjusted to

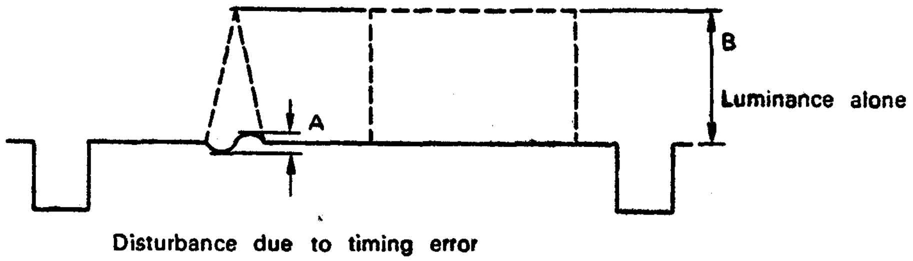
---

*Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

*Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).



a) Chrominance delayed relative to luminance.



b) Disturbance due to timing error

FIG. 16 LUMINANCE/CHROMINANCE TIMING ERROR MEASUREMENT

provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5)-1983* so that noise effects do not influence measurement. The radio-frequency signal is modulated by the output of a suitable colour system coder. The input signals to be coded consists of a constant pedestal signal of 50 percent maximum amplitude to the blue input and 14 percent maximum amplitude to the green input with no signal applied to the red channel. An oscilloscope is connected to a suitable point to observe the $G - Y$ signal or where this is not available, the green signal. The chrominance signal is switched off at the coder and the signal level on the oscilloscope observed. The chrominance signal is restored and the amplitude of the green input is adjusted for zero $G - Y$ output, that is, the same level as when the chrominance signal was not present. The level of the green input signal to the coder is measured.

NOTE — Where the $G - Y$ signal is observed, measurement may be facilitated by using a line rate square-wave for the blue and green input signals permitting observation of the amplitude under both conditions without the need to switch off the chrominance signal at the coder.

14.3 Presentation of Results — The result of the measurement is expressed as the percentage error of the $B - Y$ signal contribution to the $G - Y$ signal calculated as follows.

From the measured value of the green signal input to the coder and the known blue signal input, the equivalent values of $R - Y$ and $B - Y$ are calculated using the standard formulation for Y, the luminance signal that is $Y' = 0{\cdot}30\ R' + 0{\cdot}59\ G' + 0{\cdot}11\ B'$. The values are normalized for unit value of $R - Y$ by dividing the coefficient of $B - Y$ by the coefficient of $R - Y$. The resulting decimal fraction is expressed as a percentage of 0·37, this being the nominal ratio of $B - Y$ and $R - Y$ contribution to $G - Y$. This percentage represents the measured contribution of $B - Y$ to the $G - Y$ signal.

15. PRIMARY COLOUR SIGNAL MATRIXING ERROR (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

15.1 Definition — These measurements define the accuracy with which the blue and green primary colour signals are formed from the luminance and colour difference signal components, with the receiver adjusted to correctly proportion the red colour separation signal.

15.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver must be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983* and is adjusted to provide standard video output

---

*Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983* so that noise effects do not influence measurement. The radio-frequency signal is modulated by the output of a suitable colour system coder. The signals applied to the coder are constant pedestal signals of 60 percent maximum amplitude to the red, blue and green inputs. An oscilloscope is connected to observe the red primary colour signal where it is applied to the picture tube. Where luminance and chrominance signals are applied to separate terminals of the picture tube, the primary colour signal may be observed by using an oscilloscope with differential inputs. The level of the signal at the red output is noted and the blue and green inputs to the coder removed. If necessary, the receiver chrominance channel gain control is adjusted to provide the same output level as existed when all three inputs were applied to the coder. The oscilloscope is now transferred to the blue signal output to the picture tube and the signal level noted with the signal applied to all three coder inputs as before.

The red and green inputs to the coder are removed and the level of the signal noted, expressed as a percentage of that when all three inputs were applied to the coder. The oscilloscope is now transferred to the green output to the picture tube and the signal level noted with signals applied to all three coder inputs as before. The red and blue inputs to the coder are removed and the level of the signal noted, expressed as a percentage of that when all three inputs were applied to the coder.

15.3 Presentation of Results — The results of the measurements are expressed as the percentage of the $B-Y$ contribution to the blue primary colour signal and the $C-Y$ contribution to the green primary colour signal, 100 percent being the nominal value. Calculated using the following expressions where n is the percentage obtained from the measurements in **18.2**.

Blue primary colour signal $B-Y$ contribution as a percentage of nominal

$$= \frac{100\ (n-11)}{89} \text{ percent}$$

Green primary colour signal contribution of $G-Y$ as a percentage of nominal

$$= \frac{100\ (n-59)}{41} \text{ percent}$$

16. SUPRIOUS LINE SEQUENTIAL EFFECTS (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

16.1 Definition — Receivers may show differences in signal levels or different levels of spurious signals on lines sequential in time.

16.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5)-1983† so that noise effects do not influence measurement. The radio-frequency signal is modulated by the output of a suitable colour system coder.

A colour bar signal is applied to the coder that will give rise to chrominance signals having approximately 75 percent of the maximum value. An oscilloscope is connected to the tube electrodes, in turn, to which the colour difference signals are applied. Where luminance and chrominance signals are applied to separate terminals of the picture tube, the colour difference signals are observed by using an oscilloscope with differential inputs. The oscilloscope is triggered so that lines sequential in time are superimposed. The magnitude of any line sequential level difference or the presence of any line sequential spurious signal is noted, the value being expressed as percentage of the difference between black level and white level.

16.3 Presentation of Results — The magnitudes of the measured effects are tabulated for the colour separation signal outputs, showing the levels in the various colour bars where some are more significant than others.

17. LINE TIME NON-LINEARITY, LUMINANCE SIGNAL

17.1 Definition — The non-linearity distortions in the luminance channel are measured with a five riser staircase signal of line time duration extending between black level and white level. Intermediate lines are interposed at black level or white level to cause maximum shift of the mean signal level.

---

*Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

17.2 Method of Measurement — Measurement is carried out or a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with 2 of IS : 4545 (Part 2) - 1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983† so that noise effects do not influence measurement. The radio-frequency signal is modulated by a video signal consisting of a five riser staircase in every fourth line. The intermediate three lines may be at black level or white level, as desired. An oscilloscope is connected to each electrode of the tube to which a luminance signal is applied. The departure of the amplitude measured at the centre of each step from its nominal amplitude is expressed as a percentage of the difference between black level and white level. Measurements are made with intermediate lines both at black level and white level (*see* Fig. 17).

17.3 Presentation of Results — The measured values expressed as a percentage of the difference between black level and white level are tabulated for each electrode measured, each step of the staircase signal and the two levels of the intermediate lines.

18. LINE TIME NON-LINEARITY COLOUR DIFFERENCE SIGNALS (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

18.1 Definition — Where colour difference signals are applied to picture tube electrodes separately from the luminance signal, measurements are made of the non-linearity distortions for both positive and negative going excursions, using a five riser staircase signal of line time duration. Intermediate lines are interposed at black level and maximum level to cause maximum shift of mean signal level.

18.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983† so that noise effects do not influence measurement. The radio-frequency signal is modulated by the output of a suitable colour system coder. The signal applied to the coder consist of three lines of a five riser staircase covering the range from black level to maximum level followed by nine lines

---

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

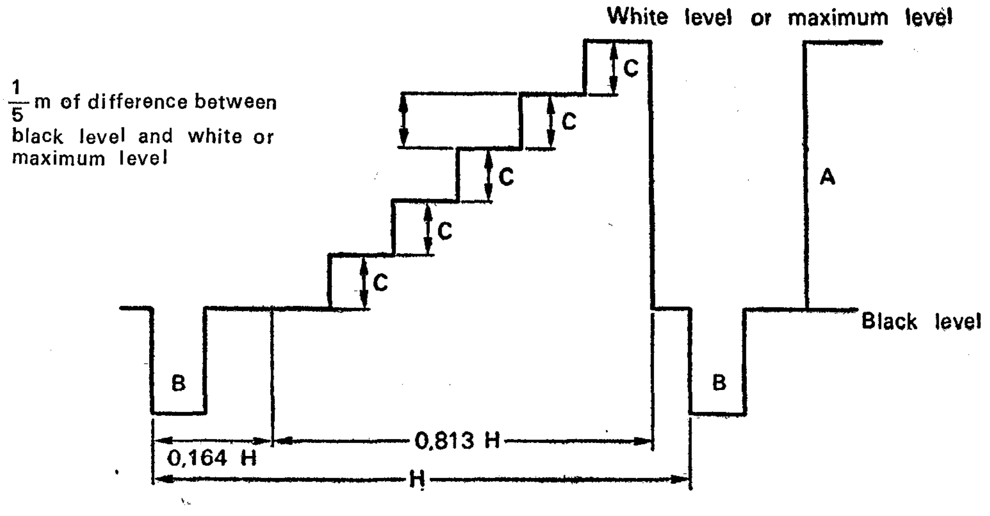

White level or maximum level
$\frac{1}{5}$ m of difference between black level and white or maximum level
C
C
C
C
C
A
Black level
B
B
0.164 H
0.813 H
H

FIG. 17 FIVE RISER STAIRCASE SIGNAL FOR NON-LINEARITY MEASUREMENTS

either at black level or maximum level. An oscilloscope is connected to the tube electrode driven by the $R-Y$ signal and the staircase signal applied to the red input of the coder.

The departure of each step from its nominal amplitude, measured in the centre of each step, is expressed as a percentage of the difference between black level and maximum level. Measurements are made with the intermediate lines at black level and maximum level. The staircase signal is then applied simultaneously to the blue and green inputs of the coder and the measurements repeated. The oscilloscope is then transferred to the electrode driven by the $G-Y$ signal and the measurements above carried out first with the staircase signal applied to the green input of the coder and then simultaneously to the blue and red inputs. The oscilloscope is then connected to the picture tube electrode driven by the $B-Y$ signal and the measurements carried out first with the staircase signal applied to the blue input of the coder and then applied simultaneously to the red and green inputs (*see* Fig. 17).

NOTE — Tor systems employing a one-line delay, four lines of chrominance component will be displayed on the oscilloscope. The second and third of these lines shall be used for measurement and first and fourth ignored.

18.3 Presentation of Results — The results of the measurements are tabulated for each of the colour difference signals and for the two coder input conditions showing the departure of each step of the staircase from its nominal amplitude expressed as a percentage of the difference between black level and maximum level, for both conditions of the intermediate lines.

19. LINE TIME NON-LINEARITY PRIMARY COLOUR SIGNALS (NOT APPLICABLE TO MONOCHROME TV RECEIVERS)

19.1 Definition — Non-linearity distortions of the primary colour signals are measured for both positive and negative going excursions of the associated colour difference signals by using a five riser and staircase signal of line time duration. Intermediate lines are interposed at black level and maximum level to cause maximum shift of mean signal level.

19.2 Method of Measurement — Measurement is carried out on a representative channel of those in which the receiver is designed to operate. The receiver shall be tuned in accordance with **2** of IS : 4545 (Part 2) - 1983* and is adjusted to provide standard video output voltage. A test pattern is applied and the receiver adjusted for optimum decoding. The radio-frequency signal is applied to the input terminals of the receiver through a vestigial sideband filter as required by the standards of the television system used and a suitable matching network. The input signal level is adjusted between those levels defined in **5** and **15** of IS : 4545 (Part 5) - 1983† so that noise effects do not influence measurement. The radio-frequency signal is modulated by the output of a suitable colour system coder. The signal applied to the coder consists of three lines of a five riser staircase covering the range from black level to maximum level followed by none lines selectably at black level or maximum level. An oscilloscope is connected to the tube electrode driven by the primary red colour signal and the staricase signal applied to the red input of the coder. The departure of each step from its nominal amplitude measured in the centre of each step is expressed as a percentage of the difference between black level and maximum signal level, with the intermediate lines both at black level and maximum level. The measurements are repeated with the staircase signal applied simultaneously to the red and blue inputs to the coder. The oscilloscope is then transferred to the electrode driven by the primary blue colour signal and the measurements above carried out with the staircase signal applied first to the blue input of the coder and then simultaneously to the blue and green inputs. The oscilloscope is then connected to the picture tube electrode driven by the green primary colour signal and measurements carried out with the staircase signal applied to the green input of the coder. The measurements are then repeated with the staircase signal applied to the green and red inputs of the coder (*see* Fig. 17).

19.3 Presentation of Results — The results of the measurements are tabulated for each of the primary colour signals showing the departure of each step of the staircase from its nominal amplitude expressed as a percentage of the difference between black level and maximum level for the two coder input conditions and both conditions of the intermediate lines.

---

*Methods of measurement on receivers for television broadcast transmissions: Part 2 Tuning properties and general measurements (*first revision*).

†Methods of measurement on receivers for television broadcast transmissions: Part 5 Sensitivity (*first revision*).

INDIAN STANDARDS INSTITUTION

Headquarters:
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones : 331 01 31, 331 13 75

Telegrams: Manaksanstha
(Common to all offices)

	Telephone
Regional Offices:	
*Western : Manakalaya, E9 MIDC, Marol, Andheri (East), BOMBAY 400093	6 32 92 95
†Eastern : 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	36 24 99
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	2 18 43 3 16 41
Southern : C.I.T. Campus, MADRAS 600113	41 24 42 41 25 19 41 29 16
Branch Offices :	
'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001	2 63 48 2 63 49
'F' Block, Unity Building, Narasimharaja Square, BANGALORE 560002	22 48 05
Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, BHOPAL 462003	6 67 16
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	5 36 27
53/5 Ward No. 29, R.G. Barua Road, 5th Byelane, GUWAHATI 781003	—
5-8-56C L.N. Gupta Marg (Nampally Station Road), HYDERABAD 500001	22 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	6 34 71 6 98 32
117/418B Sarvodaya Nagar, KANPUR 208005	21 68 76 21 82 92
Patliputra Industrial Estate, PATNA 800013	6 23 05
Hantex Building (2nd Floor), Railway Station Road, TRIVANDRUM 695001	52 27
Inspection Office (With Sale Point):	
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

---

*Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007	89 65 28
†Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072	27 68 00

Printed at Swatantra Bharat Press, Delhi, India